

A massive binary black-hole system  
in OJ 287 and a test of general  
relativity (Valtonen et al. Nature April 17)

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# Tests of general relativity

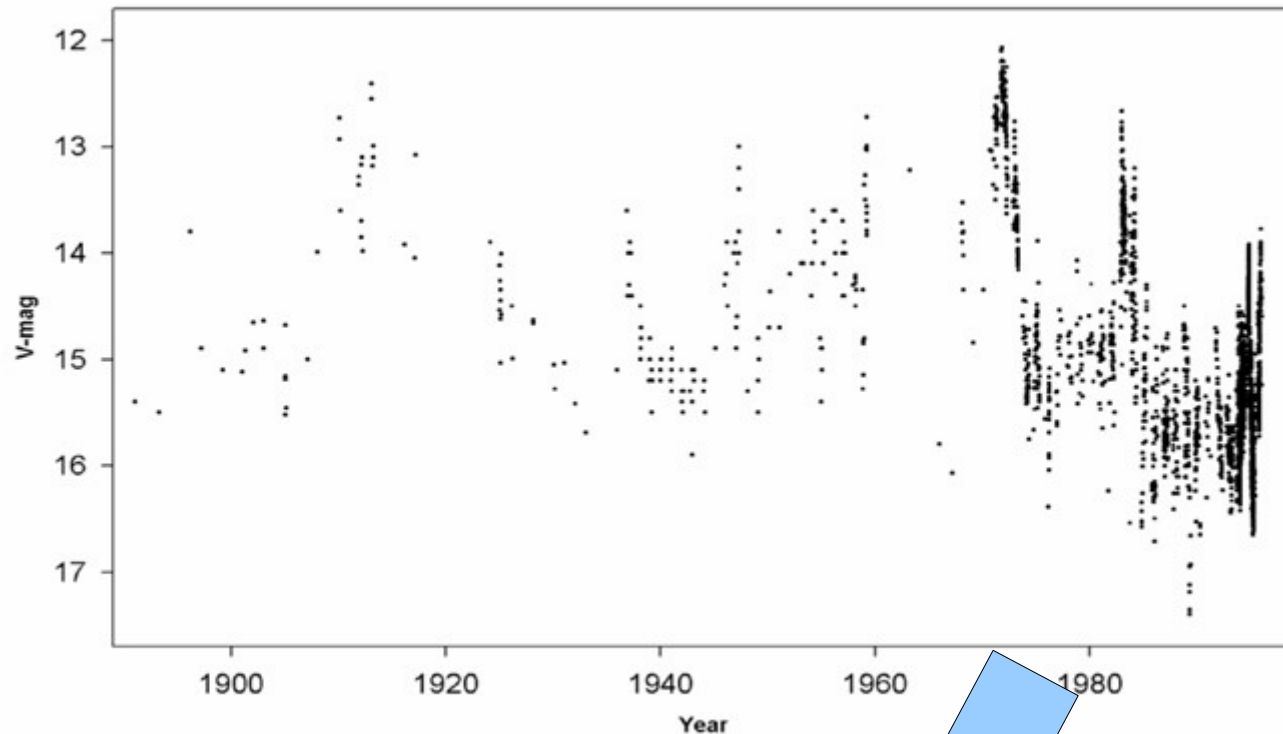
- Gravitation lensing.
- Precision of Mercury orbit.
- Gravitational wave (using a binary system including a pulsar)

OJ 287 (quasar) provides an  
another system for testing the GR.  
1 space curvature  
2 gravitation wave

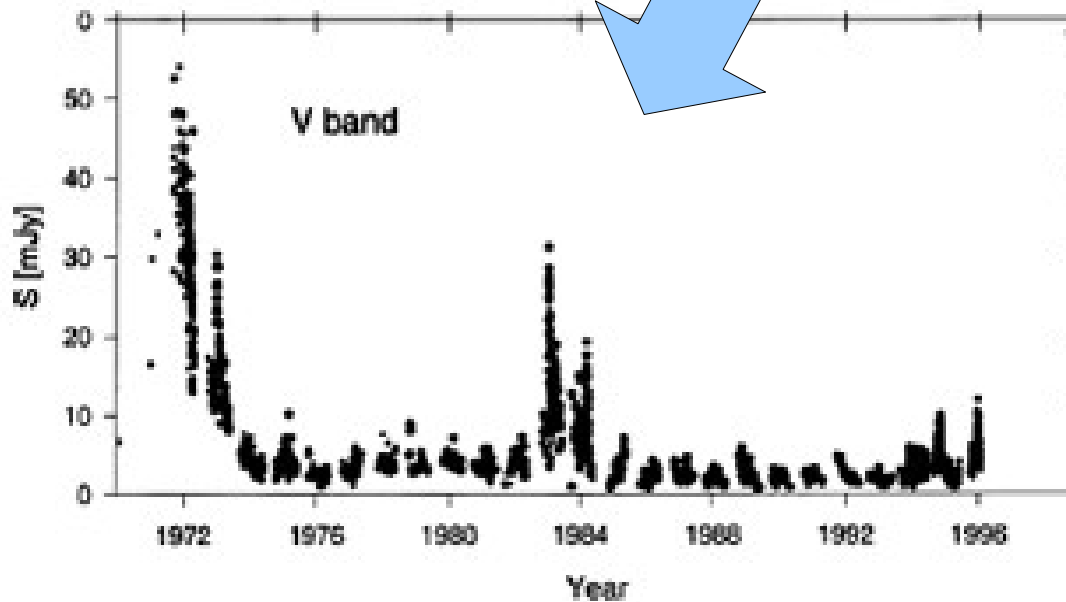
# OJ 287

- A blazer,  $z \sim 0.306$
- Quasi-periodic optical out bursts at about 12 yrs intervals, with two peaks per interval.
- A flare in September 13 2007.

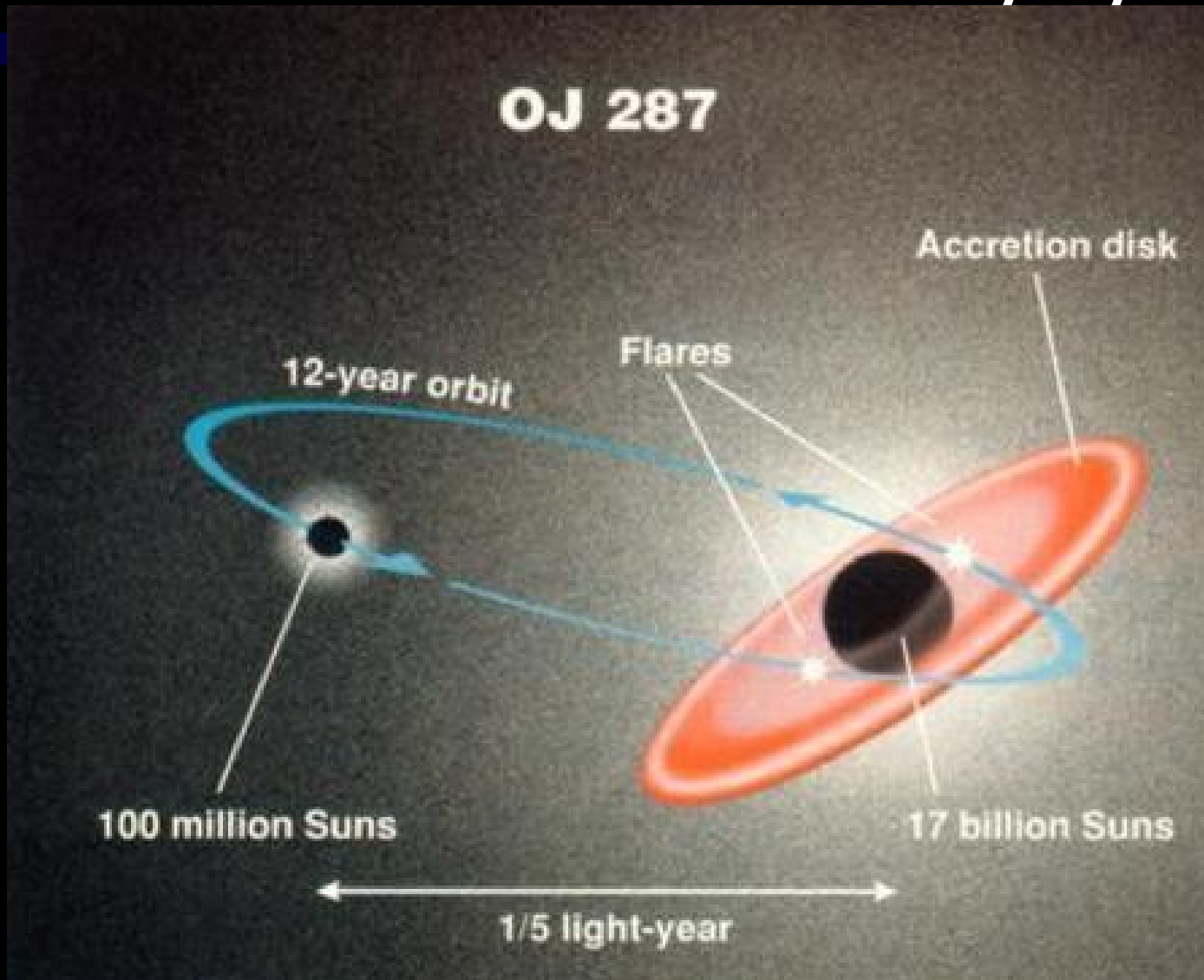
Historical V-magnitude light curve of OJ 287 (1891-1997)



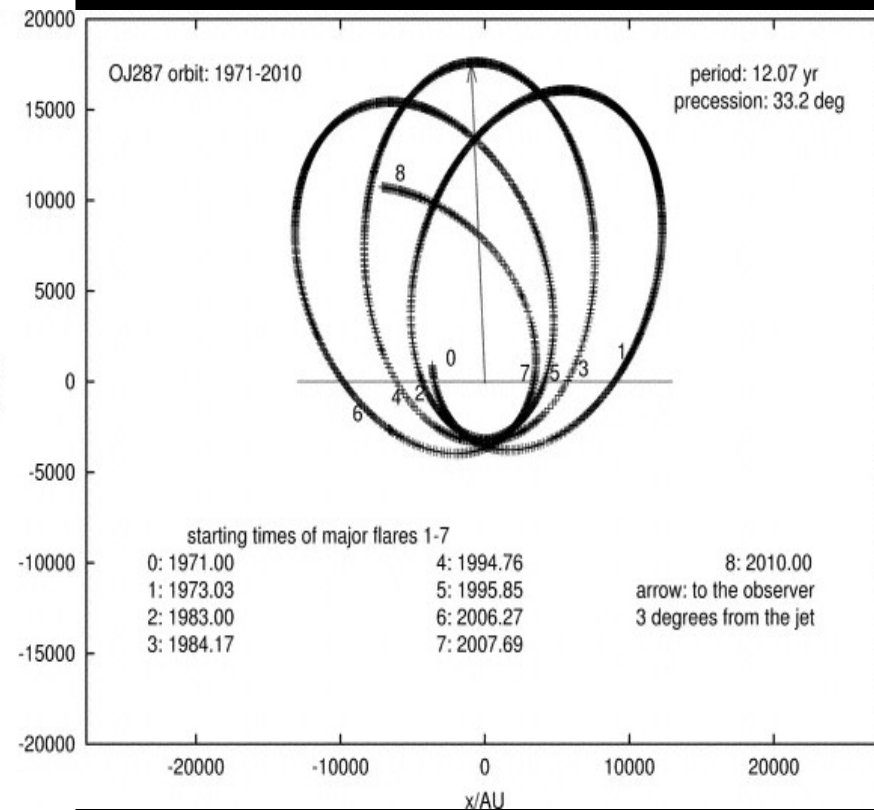
Courtesy of A. Sillanpää



# Black hole-Black hole binary system



A post-Newtonian orbit integrator is used  
(precession, orbital changes depends on the  
choice parameters)



Period;  $P=12.07\text{yr}$  - Interval of flares

Eccentricity ;  $e\sim 0.685$  - The time  
interval between plane (disk) crossing  
of the secondary black hole

Precession; Changes of the time  
intervale between plane crossing.

# First identify of 2-order post Newtonian effect

If we consider only first order post  
Newtonian effect for the orbital  
integrator, the flares in 2007 must  
starts 10days earlier.



# Test of gravitational wave

If the system does not lose the energy by the gravitational wave, the outburst time in 2007 September 13 should be delayed about 20 days.

Next major flare is expected in early January 2016, at which this will be a good target for the detector of gravitational wave.